heat is increased by reversing or even simply interrupting the current, which is in accordance with the modern theories on thermodynamics and molecular polarization. But all these experiments are merely preliminary studies in a field of vast and increasing importance, the cultivation of which may ultimately lead to the greatest discovery of modern times, the determination and application of the laws by which the material universe is governed even in phenomena of a psychic order.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 8.—"Contributions to the Anatomy of the Central Nervous System of Vertebrate Animals: Anatomy of the Brain of *Ceratodus forsteri*." By Alfred Sanders, M.R.C.S., F.L S.

The brain of Ceratodus has the following general arrangement: the membrane which represents the pia mater is of great thickness and toughness; there are two regions where a tela choroidea is developed; one where it covers in the fourth ventricle, and the other where it penetrates through the third ventricle and separates the lateral ventricles from each other.

The thalamencephalon and the mesencephalon are narrow, and the medulla oblongata is wide. The ventricles are all of large size, and the walls of the lateral ventricles are not completed by nervous tissue. All the cranial nerves are to be seen except the abducens and the hypoglossal. There is a large communicating branch between the trifacial and the vagus. The glossopharyngeal has no separate root, but is a branch of the vagus; the ganglion of the vagus is not the termination of the main trunk, but is an off-shoot from the ramus lateralis; the ganglion gives off the branchial nerves and the ramus intestinalis, the ramus lateralis passing on without entering it.

The minute structure of the dorsal part of the cerebrum presents four layers: externally a layer of finely granular neuroglia, with slight indications of radial striation; next a layer of larger-sized cells; then another layer of neuroglia, with fibrillæ having a tendency to a longitudinal direction; and internally a layer of rounded cells closely crowded together. The ventral part of the cerebrum has only two layers, the external of neuroglia, and the internal of rounded cells.

The olfactory lobes resemble the cerebrum in structure, there is an internal layer of cells continuous with those of the cerebrum, and an external layer of glomeruli olfactori, which seem as if they were the external layer of the cerebrum condensed; and between the two, a layer of longitudinal fibres, on which fusiform cells are developed.

The optic lobes also consist of four layers: externally there is a layer of longitudinal fibrils derived from the optic tract; then a layer of smoothly granular neuroglia; then a layer of transverse fibrillæ which collect into a commissure in the central line at the dorsal surface. This layer also contains fusiform and rounded cells sparsely scattered through it; and internally there is a layer of cells mostly rounded. At the central line on the dorsal surface there is a ganglion of large cells resembling those of the optic lobe of the Plagiostomata.

The cerebellum is a mere bridge over the fourth ventricle. Its structure presents the usual number of layers: internally the fibrous layer, which ultimately forms the crura cerebelli ad medullam; then the granular layer, the cells of which are of large size compared to those of the same layer in Teleostei and Plagiostomata; then a layer of Purkinje cells, of which the form and the number of processes are not uniform; externally is the molecular layer, which consists of a coarsely granular network derived from the processes of the Purkinje cells, also a network of finer fibrils and many rounded cells.

In the spinal cord there are three columns of longitudinal fibres on each side in the white substance: viz. the ventral columns between the two ventral roots of the spinal nerves; the lateral columns between the dorsal and ventral roots; and the dorsal columns between the two dorsal roots. Fibres of large size are scattered throughout the two former columns, but collected principally in the ventral. The dorsal consists entirely of minute fibres.

The principal feature in the white substance is a fibre of gigantic size, which is situated on the summit of the ventral columns, one on each side; it consists of a common medullary sheath; inclosing (where the fibre is largest) about 40 to 50 axis-cylinders; these have the character of the axis-cylinders of the ordinary fibres of the white substance, but have no separate medullary sheaths; this fibre is traceable throughout the spinal cord; commencing opposite the posterior end of the abdomen, it extends to a short distance behind the exit of the facial nerve; it varies in size, and becomes of the greatest diameter near the posterior end of the medulla oblongata; its axes escape through the medullary sheath, and join the longitudinal fibres of the ventral columns. Near its anterior termination all the axes have escaped except one; at this point it bears a great resemblance to Mauthner's fibre in the Teleostei. This remaining fibre decussates with that of the other side a short distance behind the exit of the facial nerve, and enters the root of that nerve on the opposite side.

In the gray substance of the spinal cord, there are two series of ganglia, one in the ventral horn, which consists of multipolar cells often of very large size. They send processes into the ventral and lateral columns, which often become the smaller-sized longitudinal fibres. The cells of the other series of ganglia are of smaller size, and are situated in the substantia gelatinosa centralis; they are smooth in outline, and give off one or two processes; they probably have to do with the dorsal roots of the spinal nerves. Cells also of this kind occur at other places, as in the fibræ rectæ, and in the field of the ventral columns.

The transverse commissures are: one in the spinal cord, which passes through the substantia gelatinosa centralis over the central canal; another on the ventral side of the anterior part of the medulla oblongata, which corresponds to the commissura ansulata of the Teleostei, and is connected with the commissure in the dorsal part of the optic lobes; then there is the posterior commissure at the posterior part of the third ventricle; and a commissure at the posterior end of the cerebrum which is the anterior commissure.

There is no chiasma of the optic nerves visible externally; what there is of it, is situated in the substance of the thalamencephalon. The anterior root of the fifth nerve arises from a ganglion occupying a broad swelling at the lateral part of the gray matter of the floor of the fourth ventricle. The posterior root arises from the summit of the restiform bodies.

The facial passes backward in a small tubercle at the junction of the floor of the fourth ventricle with the restiform bodies.

The acusticus arises from a bundle of fibres which are situated on the summit of the ventral column, and appear to be a continuation forward of part of the multi-axial fibre which has not decussated.

The five roots of the vagus pass backward, and enter in succession the same tubercle as, and to the outside of, the facial nerve; the three posterior roots are double, so that the vagus is equivalent to eight nerves, and consists entirely of dorsal roots.

Two nerves are given from the ventral side of the medulla oblongata, each of which has two roots; they do not join the vagus, and pass back some distance within the vertebral canal, and emerge on a level with the exit of the dorsal roots of the spinal nerves.

The second and third spinal nerves supply the pectoral fin, and follow the course usually pursued by the hypoglossal when that nerve is present in Teleostei.

The fibres of the ventral roots of the spinal nerves enter in a direction upward and forward toward the inner edge of the multiaxial fibre, between it and the central canal, and then passing over the dorsal edge of the same are either lost in the gray substance of the ventral horn, join a process of one of the multipolar cells, or become one of the longitudinal fibres of the ventral columns of the cord.

The brain of Ceratodus presents an embryonic condition in three points: viz. first, in the extreme size of the ventricles and the tenuity of the substance of their walls; second, in the alternating origins of the dorsal and ventral roots; third, in the origin of the dorsal roots close to the central line.

Compared to Protopterus, it differs in the shape and imperfection of the cerebral lobes, and in the fact of its having a well-developed rhinencephalon; but it agrees in the narrowness of the mesencephalon, and breadth of the medulla oblongata, and in the rudimentary character of the cerebellum.

Ceratodus agrees also with the Ganoids in the comparative narrowness of the mesencephalon, and in the proportions of the cerebellum.

With the Plagiostomata it agrees in the structure of the optic lobes, both orders presenting a ganglion of large cells in the dorsal part.

With the Teleostei it agrees in the multi-axial fibre, which anterior to its termination resembles the Mauthner's fibre, also in the position and fact of its decussation.

With the Petromyzon it agrees in the structure of the tela choroidea which covers the fourth ventricle.

April 19.—"On the Heating Effects of Electric Currents, No. III." By W. H. Preece, F.R.S.

I have taken a great deal of pains to verify the dimensions of the currents as detailed in my paper read on December 22, 1887, required to fuse different wires of such thicknesses that the law

$$C = ad^{3/2}$$

is strictly followed; and I submit the following as the final values of the constant "*a*" for the different metals:—

	Inches.	Centimetres.	Millimetres.
Copper	10244 ...	2530 ...	80·0
Aluminium	7585 ...	1873 ...	59·2
Platinum	5172 ...	1277 ...	40·4
German silver	5230 ...	1292 ...	40·8
Platinoid	4750 ...	1173 ...	37·1
Iron	3148 ...	777·4 ...	24·6
Tin	1642 ...	405·5 ...	12·8
Alloy (lead and tin 2 to 1)	1318 ...	325·5 ...	10·3
Lead	1379 ..	340·6 ...	10·8

With these constants I have calculated the two following tables, which I hope will be found of some use and value:—

Table showing the Current in Amperes required to Fuse Wires of Various Sizes and Materials.

$$C = ad^{3/2}.$$

No. S.W.G.	Diameter. Inches.	$d^{3/2}$.	Copper. $a = 10244$.	Aluminium. $a = 7585$.	Platinum. $a = 5172$.	Ger. Silver. $a = 5230$.	Platinoid. $a = 4750$.	Iron. $a = 3148$.	Tin. $a = 1642$.	Tin-Lead Alloy. $a = 1318$.	Lead. $a = 1379$.
14	0·080	0·022627	231·8	171·6	117·0	118·3	107·5	71·22	37·15	29·82	31·20
16	0·064	0·016191	165·8	122·8	83·73	84·68	76·90	50·96	26·58	21·34	22·32
18	0·048	0·010516	107·7	79·75	54·37	54·99	49·95	33·10	17·27	13·86	14·50
20	0·036	0·006831	69·97	51·81	35·33	35·72	32·44	21·50	11·22	9·002	9·419
22	0·028	0·004685	48·00	35·53	24·23	24·50	22·25	14·75	7·692	6·175	6·461
24	0·022	0·003263	33·43	24·75	16·88	17·06	15·50	10·27	5·357	4·300	4·499
26	0·018	0·002415	24·74	18·32	12·49	12·63	11·47	7·602	3·965	3·183	3·330
28	0·0148	0·001801	18·44	13·66	9·311	9·416	8·552	5·667	2·956	2·373	2·483
30	0·0124	0·001381	14·15	10·47	7·142	7·222	6·559	4·347	2·267	1·820	1·904
32	0·0108	0·001122	11·50	8·512	5·805	5·870	5·330	3·533	1·843	1·479	1·548

Table giving the Diameters of Wires of Various Materials which will be Fused by a Current of Given Strength.

$$d = \left(\frac{C}{a}\right)^{2/3}$$

Currents in amperes.	Diameter in inches.								
	Copper. $a = 10244$.	Aluminium. $a = 7585$.	Platinum. $a = 5172$.	German Silver. $a = 5230$.	Platinoid. $a = 4750$.	Iron. $a = 3148$.	Tin. $a = 1642$.	Tin-Lead alloy. $a = 1318$.	Lead. $a = 1379$.
1	0·0021	0·0026	0·0033	0·0033	0·0035	0·0047	0·0072	0·0083	0·0081
2	0·0034	0·0041	0·0053	0·0053	0·0056	0·0074	0·0113	0·0132	0·0128
3	0·0044	0·0054	0·0070	0·0069	0·0074	0·0097	0·0149	0·0173	0·0168
4	0·0053	0·0065	0·0084	0·0084	0·0089	0·0117	0·0181	0·0210	0·0203
5	0·0062	0·0076	0·0098	0·0097	0·0104	0·0136	0·0210	0·0243	0·0236
10	0·0098	0·0120	0·0155	0·0154	0·0164	0·0216	0·0334	0·0386	0·0375
15	0·0129	0·0158	0·0203	0·0202	0·0215	0·0283	0·0437	0·0506	0·0491
20	0·0156	0·0191	0·0246	0·0245	0·0261	0·0343	0·0529	0·0613	0·0595
25	0·0181	0·0222	0·0286	0·0284	0·0303	0·0398	0·0614	0·0711	0·0690
30	0·0205	0·0250	0·0323	0·0320	0·0342	0·0450	0·0694	0·0803	0·0779
35	0·0227	0·0277	0·0358	0·0356	0·0379	0·0498	0·0769	0·0890	0·0864
40	0·0248	0·0303	0·0391	0·0388	0·0414	0·0545	0·0840	0·0973	0·0944
45	0·0268	0·0328	0·0423	0·0420	0·0448	0·0589	0·0909	0·1052	0·1021
50	0·0288	0·0352	0·0454	0·0450	0·0480	0·0632	0·0975	0·1129	0·1095
60	0·0325	0·0397	0·0513	0·0509	0·0542	0·0714	0·1101	0·1275	0·1237
70	0·0360	0·0440	0·0568	0·0564	0·0601	0·0791	0·1220	0·1413	0·1371
80	0·0394	0·0481	0·0621	0·0616	0·0657	0·0864	0·1334	0·1544	0·1499
90	0·0426	0·0520	0·0672	0·0667	0·0711	0·0935	0·1443	0·1671	0·1621
100	0·0457	0·0558	0·0720	0·0715	0·0762	0·1003	0·1548	0·1792	0·1739
120	0·0516	0·0630	0·0814	0·0808	0·0861	0·1133	0·1748	0·2024	0·1964
140	0·0572	0·0698	0·0902	0·0895	0·0954	0·1255	0·1937	0·2243	0·2176
160	0·0625	0·0763	0·0986	0·0978	0·1043	0·1372	0·2118	0·2452	0·2379
180	0·0676	0·0826	0·1066	0·1058	0·1128	0·1484	0·2291	0·2652	0·2573
200	0·0725	0·0886	0·1144	0·1135	0·1210	0·1592	0·2457	0·2845	0·2760
225	0·0784	0·0958	0·1237	0·1228	0·1309	0·1722	0·2658	0·3077	0·2986
250	0·0841	0·1028	0·1327	0·1317	0·1404	0·1848	0·2851	0·3301	0·3203
275	0·0897	0·1095	0·1414	0·1404	0·1497	0·1969	0·3038	0·3518	0·3413
300	0·0950	0·1161	0·1498	0·1487	0·1586	0·2086	0·3220	0·3728	0·3617

May 17.—"On the Structure of the Electric Organ of *Raia circularis.*" By J. C. Ewart, M.D., Regius Professor of Natural History, University of Edinburgh. Communicated by Prof. J. Burdon Sanderson, F.R.S.

This paper gives an account of the structure of the cup-shaped bodies, which, as mentioned in a previous paper read on April 26, 1888, make up the electric organs of certain members of the skate family. The structure of these electric cups has been already studied in three species of skate, viz. *Raia fullonia*, *R. radiata*, and *R. circularis*. The present paper only deals with the electric organ of *R. circularis*. It shows that the cups in this species are large, well-defined bodies, each resembling somewhat the cup of the familiar "cup and ball." The cup proper, like the disks of *R. batis*, consists of three distinct layers, (1) the lining, which is almost identical with the electric plate of *R. batis;* (2) a thick median striated layer; and (3) an outer or cortical layer. The lining or electric plate is inseparably connected with the terminal branches of the numerous nerve-fibres, which, entering by the wide mouth in front, all but fill the entire cavity of the cup, and ramify over its inner surface, the intervening spaces being occupied by gelatinous tissue. This electric layer, which is richly nucleated, presents nearly as large a surface for the terminations of the electric nerves as the electric plate which covers the disk in *R. batis* and *R. clavata.* The striated layer, as in *R. batis*, consists of numerous lamellæ, which have an extremely contorted appearance, but it differs from the corresponding layer in *R. batis*, in retaining a few corpuscles. The cortical layer very decidedly differs in appearance from the alveolar layer in *R. batis.* It is of considerable thickness, contains large nuclei, and sometimes has short blunt processes projecting from its outer surface. These short processes apparently correspond to the long complex projections which in *R. batis* give rise to an irregular network, and they seem to indicate that the cortical layer of *R. circularis* essentially agrees with the alveolar layer of *R. batis*, differing chiefly in the amount of complexity. Surrounding the cortex there is a thin layer of gelatinous tissue in which capillaries ramify. This tissue evidently represents the thick gelatinous cushion which lies behind the disk in *R. batis*, and fills up the alveoli.

The stem of the cup is usually, if not always, longer than the diameter of the cup. It consists of a core of altered muscular substance, which is surrounded by a thick layer of nucleated protoplasm continuous with the cortical layer of the cup, and apparently also identical with it.

The cups are arranged in oblique rows to form a long, slightly-flattened spindle, which occupies the posterior two-thirds of the tail, being in a skate measuring 27 inches from tip to tip, slightly over 8 inches in length, and nearly a quarter of an inch in width at the widest central portion, but only about 2 lines in thickness.

The posterior three-fifths of the organ lies immediately beneath the skin, and has in contact with its outer surface the nerve of the lateral line. The anterior two-fifths is surrounded by fibres of the outer caudal muscles. It is pointed out that while the organ in *R. circularis* is larger than in *R. radiata*, it is relatively very much smaller than the organ of *R. batis.*

Linnean Society, April 19.—Mr. Carruthers, F.R.S., President, in the chair.—Prof. Martin Duncan exhibited a specimen of *Heterocentrotus mamillatus*, showing the apertures of three of the genital ducts to be in the median interradial sutures, the corresponding basal plates being imperforate. A discussion followed, in which Mr. W. Percy Sladen and Dr. C. Stewart took part.—Mr. George Murray exhibited some specimens of *Spongocladia*, with explanatory coloured diagrams, and made some interesting remarks on the presence of sponge-spicules on Algæ at present unaccounted for.—Mr. D. Morris, of Kew, exhibited, and made remarks upon, the bird-catching sedge, *Uncinia jamaicensis.*—Mr. John R. Jackson, of Kew, exhibited some table mats from Canada made of the highly scented grass *Hierochloa borealis*, and a sample of the so-called pine wool prepared from the leaves of the American long-leaved or turpentine-yielding pine, *Pinus australis*, with a mat made from the wool, an industry which has recently been started on a large scale at Wilmington, North Carolina.—Mr. J. E. Harting exhibited a living specimen of Natterer's bat, which had been captured the previous day at Christchurch, Hants, together with a water-colour drawing from life of Daubenton's bat recently taken at the same place.—The first paper of the evening was by the Rev. George Post (communicated by Mr. Thiselton Dyer), and contained descriptions of new plants from Palestine. In the absence of the author, the salient points in the paper were admirably demonstrated by Mr. J. G. Baker, F.R.S., who exhibited specimens of the plants alluded to.—A paper was then read by the Botanical Secretary, Mr. B. Daydon Jackson, on behalf of Prof. Fream, on the flora of water meadows. An interesting discussion followed, and the meeting adjourned.

May 3.—Dr. John Anderson, F.R.S., Vice-President, in the chair.—The Chairman announced a resolution of the Council to found a gold medal, to be called the "Linnean Medal," to be awarded at the forthcoming anniversary meeting to a botanist and zoologist, and in future years to a botanist and zoologist alternately, commencing with a botanist.—Dr. Francis Day exhibited some specimens of Loch-leven and sea trout raised at Howietoun to illustrate his observation that the markings usually relied upon to distinguish the species are not constant, and therefore, taken alone, of no value for the purpose of identification. He also exhibited specimens of trout from Otago, New Zealand, descendants of some which had been introduced there, presenting some curious modifications of structure. A discussion followed, in which some interesting remarks were made by Prof. Howes and Mr. Willis Bund.—On behalf of Mr. Miller Christy, the Botanical Secretary (Mr. B. Daydon Jackson) exhibited some specimens of the Bardfield oxlip (*Primula elatior*, Jacquin), gathered near Dunmow, and occurring only in this part of England (cf. Trans. Essex Field Club, iii. p. 148).—Mr. A. D. Michael read a paper on the life-histories of the Acari *Glyciphagus domesticus* and *G. spinipes.* After describing in detail observations and dissections extending over three years, the author concludes that there is a hypopial stage in the life-history of *Glyciphagus*, but far less developed than in *Tyroglyphus*, and not an active stage in the species observed; that it does not occur to all individuals of a species, and it has not been ascertained whether it occurs in all species; that the stage is not the result of desiccation or unfavourable conditions; and that it occupies the period between the penultimate ecdysis and that immediately previous. Dr. C. Stewart criticized Mr. Michael's researches in favourable terms. —A communication was then made by Mr. C. B. Clarke on root-pressure. He contested the view of A. Sachs (and his followers) that root-pressure is sufficient to sustain the weight of a column of water of the height of 100 (or even 30) feet, and to force out drops at particular points of the leaves. He maintained that it was a mathematical error to apply the equation $p = g\rho z$ to the case of water in plants, and that in a collection of cells and longitudinal tubes of varying size (all very small) the only mechanical ideas that could be applied were those of capillary attraction and motion. In the discussion which followed, Prof. Marshall Ward thought root-pressure necessary to explain the admitted results of manometer experiments. Mr. A. W. Bennett, on the other hand, regarded the assumption of a high fluid tension in the cells of roots to drive moisture to the summits as nothing more than an expression of our ignorance as to what the water does move.—A paper on the ovicells of some Lichenoporæ was read by the Zoological Secretary (Mr. W. Percy Sladen in the absence of the author, Mr. A. W. Waters.

Physical Society, April 28.—Prof. Reinold, F.R.S., President, in the chair.—The following communications were read:—On electromotive force by contact, by Mr. C. V. Burton. The object of the paper is to discuss the seats of the electromotive forces developed by the contact of conductors. By considering the distribution of electricity on the surfaces of the conductors, and from the fact that the potentials throughout their masses are constant, except about a thin layer near the junction, the author deduces that "*the molecular action which gives rise to a contact E.M.F. between two conductors is confined to the immediate neighbourhood of the junction.*" If E be the contact E.M.F., and M the quantity of electricity which passes across the junction when two metals originally at the same potential are placed in contact, it is shown that the work done is EM, half of which is spent in producing heat and half in raising the potential energy of the system. Since the conductors are supposed to be kept at constant temperature, and the action which gives rise to the E.M.F. is confined to the immediate neighbourhood of the junction, the molecular energy must be absorbed at the junction. By supposing the surface of contact very small, and the capacity of the system large, it is shown that *heat* and *chemical action* are the only kinds of energy which fulfil the required conditions of supplying an indefinite amount of energy. Hence, for substances chemically inactive, "*the true contact E.M.F. is equal to their coefficient of the Peltier effect* *expressed in absolute measure*"; and for substances chemically active, but devoid of Peltier effect, "*the E.M.F. is equal to the energy of combination of one electro-chemical equivalent.*" Since metal-metal contacts can only be the seats of Peltier E.M.F.'s it is inferred that the apparent contact E.M.F. (measured inductively) must be due chiefly to air-metal contacts. A list of analogous properties of Peltier and chemical E.M.F.'s is given in parallel columns. The results of some experiments on the contact E.M.F. of glass and ebonite with mercury are tabulated, but they are very irregular, and the author concludes that there is no true and definite contact E.M.F. between conductors and non-conductors. Profs. Ayrton, Schuster, Thompson, and Perry discussed the points raised, and it was considered that direct experiment on contact E.M.F. in a very perfect vacuum could alone decide the questions.—On a theory concerning the sudden loss of magnetic properties of iron and nickel, by Mr. H. Tomlinson. Experiments by himself and other observers have shown that the temperatures at which iron and nickel lose their magnetic properties depend on the specimens used, and the magnetizing forces employed; but the temperature at which they *begin to lose* these properties are definite—for nickel about 300° C., and iron about 680° C. The author's own experiments on "Recalescence of iron" show two critical temperatures; and Pinchon has shown by calorimetric measurements that between 660° and 720° C., and between 1000° and 1050° C., heat becomes latent. All these facts seem to indicate a molecular rearrangement about these temperatures. In his proposed theory, he assumes that the molecules of iron (say) contain magnetic atoms capable of motions of translation and of rotation. These tend to form closed magnetic circuits, but at ordinary temperatures are unable to do so on account of the close proximity of their centres. On raising the temperature, their centres are further separated till at about 680° C. their polar extremities rush together, forming complete circuits and exhibiting no external magnetic properties. On cooling down, the centres approach until the gravitation attraction overcomes the magnetic attraction of their poles, when the magnetic properties reappear. Prof. Ayrton asked whether the author had made experiments on the reappearance of magnetic properties when raised to a white heat, and Prof. Thompson inquired whether cobalt had been tested. Both questions were answered negatively.—Note on the graphic treatment of the Lamont-Frolich formula for induced magnetism, by Prof. S. P. Thompson. The formula referred to is $N = \overline{N}\,\frac{Si}{Si+b}$; where N = total induction when saturated, N = induction due to Si ampere turns, and b = value of Si which makes $N = \frac{1}{2}\overline{N}$. Simple geometrical constructions are given for plotting the curve when $\overline{N}$ and b are known, and for finding $\overline{N}$ and b when two pairs of values of N and Si have been determined. The use of the formula is shown to be justified in practice, for, as pointed out to the author by Prof. Perry, the curves connecting permeability, μ, and induction, B, are straight lines from B = 7000 to B = 16,000, between which dynamos are usually worked. A method of predetermining $\overline{N}$ and b is given for magnetic circuits of known form and materials, thus removing the objection often urged against the above formula, viz. that it involves two constants which had to be determined after the magnet was made.

Mathematical Society, May 10.—Sir J. Cockle, F.R.S., President, in the chair.—Mr. E. B. Elliott communicated a fourth paper on cyclicants or ternary reciprocants and allied functions.—Mr. Cook Wilson gave a sketch of some theorems on parallel straight lines, together with some attempts to prove Euclid's twelfth axiom. Messrs. Elliott, Buchheim, and Prof. Henrici, F.R.S., took part in a lengthened discussion of the paper.—The following were taken as read:—On the flexure and the vibrations of a curved bar, by Prof. H. Lamb, F.R.S.—On the figures formed by the intercepts of a system of straight lines in a plane and on analogous relations in space of three dimensions, by S. Roberts, F.R.S.—On Lamé's differential equation; and stability of orbits, by Prof. Greenhill.

Entomological Society, May 2.—Dr. D. Sharp, President, in the chair.—Dr. P. B. Mason exhibited an hermaphrodite specimen of *Saturnia carpini*, from Lincoln, and another specimen of the same species with five wings, bred at Tenby.—Herr Jacoby exhibited female specimens of *Chrysomela japana*, collected by Mr. J. H. Leech in Japan, and called attention to a sexual structure in the middle of the abdominal segment.—Mr. Adkin exhibited a variety of *Eubolia bipunctaria*, taken at Box Hill.—Mr. W. F. Kirby exhibited, for Dr. Livett, a curious discoloured female specimen of *Ornithoptera minos*, Cramer.—Mr. H. Goss exhibited, for Mr. W. Denison-Roebuck, a number of specimens of an exotic species of bee obtained by the Rev. W. Fowler, of Liversedge, from split logwood. The cells or pouches were very irregular and rough, and altogether unlike those of any known British species.—Dr. J. W. Ellis read a paper entitled "Remarks on the British Specimens of *Aphodius melanostictus*, Schmidt," and he exhibited a number of specimens and drawings of this species and of *Aphodius inquinatus*, F. A discussion ensued, in which Dr. P. B. Mason, Dr. Sharp, Mr. Champion, and Dr. Ellis took part.—Mr. E. Meyrick communicated a paper on the Pyralidina of the Hawaiian Islands, the material for which paper consisted principally of the collection of Lepidoptera Heterocera formed by the Rev. T. Blackburn during six years' residence in the Hawaiian Islands. Mr. Meyrick pointed out that the exceptional position of these islands renders an accurate knowledge of their fauna a subject of great interest. He stated that, of the fifty-six known species of Hawaiian Pyralidina, nine had probably been introduced through the agency of man in recent times; but he believed the remaining forty-seven to be wholly endemic: of these latter the author referred twenty-six species to the *Botydidæ*, twelve to the *Scopariadæ*, four to the *Pterophoridæ*, three to the *Crambidæ*, and two to the *Phycitidæ*. Dr. Sharp, Mr. McLachlan, Dr. Mason, and Mr. E. B. Poulton took part in the discussion which ensued.

PARIS.

Academy of Sciences, May 14.—M. Janssen, President, in the chair.—On diamagnetism, by M. Mascart. In connection with M. Blondlot's recent communication describing an experiment on the apparent diamagnetism of a solution of the perchloride of iron in a more concentrated solution of the same substance, it is pointed out that in 1845 Faraday showed that the action of the magnetic forces on a body depends on the medium in which it is plunged, as it results from the difference of their coefficients of magnetic induction. If the intensity of magnetization remains proportional to the magnetizing force, which is the case with all diamagnetic and slightly magnetic bodies, the theory then shows that the magnetizm on the surface of the body in question changes its sign when the outer medium has a high coefficient.—Remarks accompanying the presentation of a map of Massaya in Abyssinia, by M. d'Abbadie. Attention was drawn to some cartographic improvements introduced into this map by the author with the view of rendering the nomenclature more distinct, and more in accordance with the local pronunciation of geographical names. In all cases such foreign descriptive terms as *Ras*, *Jebel*, &c., give place to their equivalents *Cape*, *Mount*, &c.—Fluorescence of cupriferous lime, by M. Lecoq de Boisbaudran. After calcination in the air, carbonate of lime containing a little oxide of copper yields a substance which gives in vacuum an extremely bright green fluorescence. No spectral rays have been observed. When calcination takes place in hydrogen, instead of the green fluorescence, a more or less pink or reddish light is obtained, at times somewhat intense, but always greatly inferior to the green fluorescence.—Observations of the new planet 277, discovered on May 3, at the Observatory of Nice, by M. Charlois. The observations extend over the period from May 3 to May 9, when the planet appeared to be of the thirteenth magnitude.—Observations of the same planet are recorded for the period May 5–12, taken by M. Trépied, at the Observatory of Algiers.—Observations of the channels in Mars, by M. Perrotin. Some important modifications are described, that have taken place in these appearances since they were first observed by the author in 1886. The triangular continent, somewhat larger than France (the Lybia of Schiaparelli's map), which at that time stretched along both sides of the equator, and which was bounded south and west by a sea, north and east by channels, has disappeared. The place where it stood, as indicated by the reddish-white tint of land, now shows the black, or rather deep blue colour of the seas of Mars. The Lake Mœris, situated on one of the channels, has also vanished, and a new channel, about 20° long and 1° or 1°·5 broad, is now visible, running parallel with the equator to the north of the vanished continent. This channel forms a direct continuation of a previously existing double channel, which it now connects with the sea. Another change is the unexpected appearance about the north pole of another passage, which seems to connect two neighbouring seas through the polar ice.—Action of hydrochloric acid on the solubility of stannous chloride; hydrochlorate of stannous chloride, by M.

Engel. It is generally assumed that the solubility of stannous chloride in water increases in the presence of hydrochloric acid. But the experiments here described show that this is the case only when the quantity of acid added to the saturated solution of the chloride attains a certain value. The hydrochlorate of stannous chloride, here also described, has for formula, $SnCl_2 + HCl_2 + 3H_2O$. It crystallizes and melts at about $-27°$.—On the existence of a pyrophosphorous acid, by M. L. Amat. The existence here demonstrated of this body is a brilliant verification of the theory of Wurtz regarding the constitution of the phosphorous and hypophosphorous acids.—Essay on the equivalents of the simple bodies, by M. Delauney. Taking as unity the equivalent of hydrogen, the equivalents of the simple bodies may be obtained by the expression, $\frac{N}{3}\sqrt{5^2 - n^2}$, where N and n are integers, the values of n being obviously restricted to 0, 1, 2, 3, or 4. According to these several values of n the elementary bodies are disposed in so many family groups, from which chlorine alone is excluded, while its neighbour, bromine, appears to belong to as many as three of the groups. This classification seems natural, the first family supplying the true metals—copper, gold, lead—below which, in the descending scale, the fifth family corresponds to the alkaline metals and metalloids. From all this is deduced a curious molecular theory based on the assumption of a primitive molecule formed of six atoms. Around one of these the other five describe circles with radii 1, 2, 3, 4, 5, all moving in the same plane, and the central atom revolving round its own axis perpendicular to the plane. The atoms at the distances 1, 2, 3, 4 revolve in the same direction as the central, the outer in the contrary direction, the molecule thus constituting a sort of astronomic system, infinitely small, but analogous to the stellar groups. All these considerations go to confirm in principle, if not in fact, the views of those chemists who hold that all the simple bodies are ultimately reducible to one—that is, hydrogen.—Researches on the synthesis of the albuminoid and proteic substances, by M. P. Schutzenberger. Having completed his analytical studies of albumen, fibrine, caseine, gelatine, and other proteic substances, the author has now begun the study of their synthesis. In this paper the first results are given, showing that the leuceine obtained by the synthetic process is identical with that yielded by decomposition.

BERLIN.

Physiological Society, April 27.—Prof. du Bois-Reymond, President, in the chair.—Dr. Blaschko spoke on the development of horny tissue. Between the rete Malpighii and the corneous layer (stratum corneum) of the epidermis two layers are found—the stratum granulosum and the stratum lucidum—in which the cells of the rete, produced karyokinetically, must undergo their conversion into the epidermal cells of the stratum corneum. The speaker confined himself first to a consideration of the granules of the stratum granulosum, about which most widely different views have been advanced by various writers. They have been regarded as consisting of fat, cholesterin, amyloid substance, proteid, keratin, and hyalin; and further as fluid, semi-fluid, or solid. Dr. Blaschko has satisfied himself that the granules are not fluid, but that they contain more water than the cells of the epidermis. He has further proved by employing all the chemical reactions which are characteristic of such different substances as fat, cholesterin, proteid, &c., that the granules cannot be regarded as composed of any of the above. The curious colour they assume when stained with hæmatoxylin, and their behaviour with chemical reagents, shows that their proper place is one intermediate between albumen and keratin; the speaker hence proposed to give the name of prokeratin to the material of which the granules are composed.—Dr. Klaatsch had made a series of preparations from the skin of monkeys, by which he shows that it is possible, by using various colouring-matters, to give different colours to the stratum lucidum and stratum corneum in one and the same specimen, thus making it easy to distinguish these layers each from the other and from the stratum granulosum. He shows further that in the skin of monkeys, as in that of man, alternating elevations and depressions are met with; the former, or gland-hillocks, cover the glands of the skin, while the latter, or folds, are joined by tense bundles of connective-tissue passing through the rete, and thus forming an attachment for the skin. Finally, and in the third place, the preparations showed that the nuclei of the cells in the rete are still here and there recognizable in the stratum corneum as spaces which are probably formed by a disappearance of the nuclear substance, the nuclear membrane being persistent.—Dr. R. Schneider has carried on a series of researches, extending over nearly every class of animals, on the absorption of iron and on its occurrence as oxide in the organs and tissues of the animals. Up to the present time all the animals examined, whether living in water, mud, or underground, have contained oxide of iron; which was detected, using all due precautions, by employing ferrocyanide of potassium and dilute hydrochloric acid. The speaker gave an account of the behaviour of single animals taken from the Protozoa, Cœlenterates, Worms, Arthropods, Gasteropods, Fishes, and Amphibia. Among Vertebrates, oxide of iron was found in the cells of the alimentary canal, in the liver and spleen, occasionally in the kidneys and teeth, and in Proteus it occurred throughout the whole skeleton. Among the Invertebrates oxide of iron was found to occur in the cells of the liver and intestine, in the respiratory organs, the shells and chitinous envelopes. The oxide occurred chiefly in the protoplasm of the cells, but also frequently in the nuclei. It is impossible here to enlarge further upon the interesting details of which Dr. Schneider supplied an extended series.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Theoretische Geologie: Dr. E. Reyer (E. Schweizerbachsche).—Practical Lessons in the Use of English: M. F. Hyde (Heath, Boston).—The Origin of Floral Structures: Rev. G. Henslow (Kegan Paul).—The Baths and Wells of Europe, 3rd edition, revised: J. Macpherson (Stanford).—Jahrbuch der Naturwissenschaften, 1887–88: Max Wildermann (Herder, Freiburg).—A Manual of General Pathology: J. F. Payne (Smith, Elder).—Practical Zoology, 2nd edition: Marshall and Hurst (Smith, Elder).—Tropical Africa: H. Drummond (Hodder and Stoughton).—A Manual of Practical Assaying, 6th edition: J. Mitchell; edited by W. Crookes (Longmans).—Hand-book for the Stars, 4th edition: H. W. Jeans; revised by W. R. Martin (Longmans).—Descriptions of New Indian Lepidopterous Insects from the Collection of the late Mr. W. S. Atkinson; Part 3, Heterocera (continued): F. Moore (Calcutta).—Memoirs of the Geological Survey of India, Palæontologia Indica, ser. xiii., Salt Range Fossils, vol. i. Part 7: W. Waagen (Trübner).—Beiträge zur Kenntniss der Nagelfluh der Schweiz: Dr. J. J. Früh (Williams and Norgate).—Plotting, or Graphic Mathematics: Dr. R. Wormell (Waterlow).—Hylomorphism of Tnought—Being Part 1 Theory of Thought: Rev. T. Q. Fleming (Williams and Norgate).—Transactions of the Society of Naturalists of Cracow University, 1887.—Mémoires de la Société de Physique et d'Histoire Naturelle de Genève, tome xxix. seconde partie (Genève).—Brain, April (Macmillan).

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